Annals of Clinical and Analytical Medicine
Original Research

Seromucinous borderline tumor of the ovary: Correlation of MRI findings with literature

MRI findings of seromucinous borderline ovarian tumors

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Abstract

Aim: The aim of this study was to describe magnetic resonance imaging (MRI) findings of ovarian seromucinous borderline tumor (SMBT) and compare the findings with the literature.

Material and Methods: This retrospective study examined 13 patients (15 lesions) with seromucinous borderline tumors in terms of size, configuration, signal intensity (SI), and accompanying ovarian endometriosis. An experienced abdominal radiologist evaluated the MRI findings of SMBT.

Results: On MRI, 15 lesions were found. The mean age of the patients was 48.2±13.5 years. Their mean size was 150.1±68.4 mm. SMBTs appeared as complex cystic-solid masses. T2-weighted SI of the solid portion was hyperintense in almost all of the tumors. Endometriosis was present in 10 patients (66.7%). Asid was detected in 15.4% (n=2) of the patients, while peritoneal dissemination was evident in 30.8% (n=4) of the patients.

Discussion: More than half of tumors were accompanied by endometriosis. High T2-weighted SI of the solid portion could be a specific feature of ovarian SMBTs.

Keywords

Magnetic Resonance Imaging, Neoplasm, Ovary, Seromucinous Tumor, Endometriosis

DOI: 10.4328/ACAM.21773 Received: 2023-06-01 Accepted: 2023-07-10 Published Online: 2023-07-22 Printed: 2023-11-01 Ann Clin Anal Med 2023;14(11):1015-1019
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This study was approved by the Ethics Committee of Health Sciences University Tepecik Training and Research Hospital (Date: 2023-06-06, No: 2023/05-08)

Introduction

Seromucinous ovarian tumor is a newly defined category of ovarian epithelial tumor in the 2014 World Health Organization (WHO) Classification of Tumors of the Female Reproductive Organs [Kurman RJ, Carcangiu ML, Herrington CS. World Health Organisation classification of tumours of the female reproductive organs. International Agency for Research on Cancer; 2014], which was previously known as Mullerian mucinous borderline tumor (MMBT) and Mullerian mixed epithelial borderline tumor (MEBT).

Seromucinous tumors can be divided into benign, borderline, and malignant. Borderline tumors are the most common type of seromucinous tumors, with an incidence of 7.6% among all ovarian borderline tumors. As with other subtypes of ovarian borderline tumor, seromucinous borderline tumor (SMBT) could be a precursor lesion of a malignant tumor [1]. Like endometrioid and clear cell neoplasms, seromucinous borderline ovarian tumors are frequently associated with endometriosis [2,3]. These endometriosis-related ovarian neoplasms are now attracting attention because they show common molecular genetic changes such as inactivating mutation of the ARID1A tumor suppressor gene [4,5].

The imaging findings of seromucinous tumors have been discussed in a few reports about borderline tumors [6-8]. However, the radiological findings of SBMTs are still unfamiliar to radiologists.

The purpose of this study was to characterize the magnetic resonance imaging (MRI) aspects of SBMTs, as well as their clinicopathologic features, and to compare the results with the literature.

Material and Methods

Ethical consideration

The study protocol was approved by the Institutional Review Board (Approval number 2023/05-08, Date: 06/06/2023).

Patients

This retrospective study investigated the patients who underwent pelvic MRIs in the hospital between July 2016 and April 2023. Seventeen individuals with surgically and histologically confirmed SBMTs were included. Four individuals were excluded because they either did not have a preoperative MRI or were operated on at another hospital. Two of the 13 individuals that remained had bilateral lesions. Finally, preoperative MRI scans for 15 lesions that were included in the study were examined. Figure 1 illustrates the study design's flow chart.

MRI scanning protocol

MRI examinations were performed with the standard protocol using a 1.5 T MRI system (Siemens Avanto, Siemens Aera, GE Optima360) with a pelvic phased-array coil. The protocol included sagittal, axial, and coronal T2-weighted images without fat saturation, axial T2-weighted fat-saturated images, and axial T1-weighted fat-saturated gradient-echo images before and after intravenous contrast administration (Gadoteric acid, Dotarem®, Guerbet, Paris, 0.1 mmol/kg).

Image analysis

As MRI findings, among the morphological features, the tumor diameter, a signal of the solid portion on T2, the ratio of the solid to cystic part, the presence of ascites, peritoneal spread and relation with the endometriosis were evaluated.

The morphological characteristics of each tumor were divided into 3 types by visual inspection: unilocular cystic with a single nodule, unilocular cystic with multiple nodules, multilocular cystic with solid.

When interpreting MRI images, the presence of "T2 shading," was considered when the cystic portion showed lower SI on T2WI compared with a simple ovarian cyst.

"T2 WI high SI solid portion "was defined when the solid portion of the tumor presented a high SI equal to subcutaneous fat or water.

Clinical and pathological analysis

The demographic information of patients was evaluated by reviewing the clinical records of patients, including age and tumor markers. The radiologist examined the number (percentage) of patients who exhibited increased concentrations of cancer antigen (CA) 125 (≥35.0 IU/mL) and CA-19-9 (≥37.0 IU/mL).

The pathological diagnosis was done based on the pathological reports of our hospital, including tumor subtype, location (right or left or bilaterality), coexisting pathologies such as cystic endometriosis, and histopathologic stage. The histopathologic stage was determined using the International Federation of Gynecology and Obstetrics staging system.

Statistical analysis

Research data were evaluated using the SPSS version 21.0 statistical program (IBM SPSS Statistics for Windows, Armonk, NY: IBM Corp.). The conformity of continuous variables to normal distribution was investigated using visual (histogram and probability graphs) and analytical methods (Kolmogorov-Smirnov/Shapiro-Wilk tests). For the descriptive statistics of the study, mean and standard deviation in data with normal distribution, median, minimum and maximum in data that do not fit normal distribution were shown. Numbers and percentages were used to summarize descriptive statistics for categorical variables. A p-value less than 0.05 was accepted as statistically significant.

Ethical Approval

Ethics Committee approval for the study was obtained.

Results

The results are summarized in Table 1. Thirteen patients (15 lesions) diagnosed with ovarian SMBTs were included in the study. The mean age of the patients was 48.2±13.5 years. It was observed that the tumor side was unilateral in 84.6% (n=11) and bilateral in 15.4% (n=2) of the patients. The mean tumor size was 150.1±68.4 mm.

Pathological examination revealed that endometriosis was present in 10 patients (66.7%). Peritoneal dissemination was found to be present in 30.8% (n=4) and acid in 15.4% (n=2) of patients.

It was observed that 84.6% (n=11) of the tumors had a solid part and the average size was 25.6±15.5 mm. The ratio of the solid part was found to be below 10% in four tumors (30.8%), between 10-30% in 6 tumors (46.2%) and over 30% in three tumors (23.1%) of all tumors. Morphological characteristics of each tumor were divided into 3 types by visual inspection: unilocular cystic with multiple nodules, multilocular cystic with

solid and multilocular cystic without solid. Nine of the 13 tumors showed multiple nodules with unilocular (n = 4) or multilocular (n = 9) cystic masses. Of the 13 tumors, 2 were multilocular cystic masses without solid components.

On T2WI, the solid portion of tumors showed a high SI in 11 of 13 cases.

The median value of CEA 125 was 191.8 (10.1-1328.0), and the median value of CEA 19-9 was 78.5 (6-1091.0).

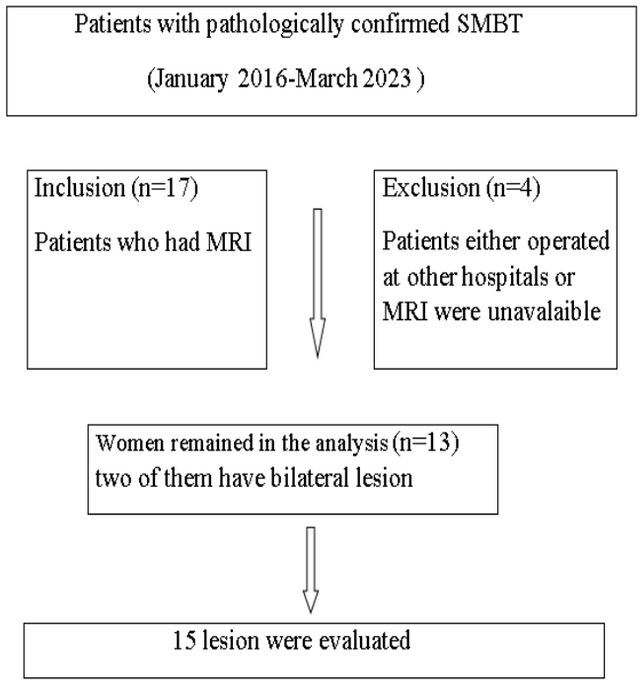

Figure 1. Flowchart of the study.

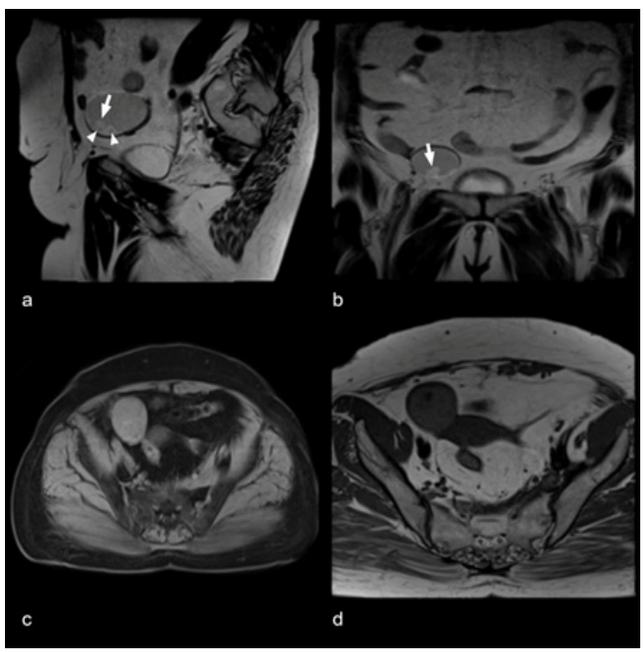

Figure 2. A 55-year-old woman with a seromucinous borderline tumor (SMBT); (a–b) T2-weighted imaging (WI), coronal and sagittal images depict the solid portion of the tumor with a high signal intensity (SI) (arrows) and a low-intensity core (arrowheads); (c-d) Intracystic fluid shows a high SI for SMBT on fat-sat T1-WI and non fat-sat T1-WI.

Table 1. Summarized imaging features of ovarian seromucinous tumors in 13 patients.

		n	%
Age (year) mean±SD		13	48,2±13,5
Tumor side n(%)	Unilateral	11	84,6
	Bilateral	2	15,4
Tumor size (mm) * mean±SD		15	150,1±68,4
Endometriosis * n(%)	No	5	33,3
	Yes	10	66,7
Peritoneal Dissemination n(%)	No	9	69,2
	Yes	4	30,8
Acid n(%)	No	11	84,6
	Yes	2	15,4
Solid portion n(%)	No	2	15,4
	Yes	11	84,6
% solid portion *	<%10	4	30,8
	%10-30	6	46,2
	>%30	3	23,1
Solid portion size mean±SD		13	25,6±15,5
Morphology type * n(%)	Multilocular with multiple nodules	9	60
	Unilocular with multiple nodules	4	26,7
	Multilocular without solid component	2	13,3
Solid portion SI T2 n(%)	High	11	84,6
	Intermediate	2	15,4
CEA 125 median(min-max)		12	191,8(10,1-1328,0)
CEA 19-9 median(min-max)		10	78,5(,6-1091,0)

* Two patients had lesions in both ovaries

Discussion

The 2014 WHO Classification of Tumors of the Female Reproductive Organs introduced seromucinous tumor, which includes borderline tumors, as a new category of ovarian tumor [Kurman RJ, Carcangiu ML, Herrington CS. World Health Organisation classification of tumours of the female reproductive organs. International Agency for Research on Cancer; 2014]. According to the literature, the most common subtype of seromucinous tumor is borderline tumor [8]. This retrospective study assessed the diagnostic value of a set of MR imaging findings of SMBT. The mean age of patients with SMBT was similar to the previous study [8,9] but younger than in the study by Karpathiou et al [10]. The mean size of seromucinous borderline tumor was 150,1±68,4 cm. This study showed different results, in which the patients were older than in the previous study. Borderline tumors were more frequent on the left side with two of them having bilateral lesions. The lesion lateralization was similar to the left-sided predominance in the literature. The appearance of tumors varied in the study. All tumors showed complex cystic masses, unilocular or multilocular with solid portions. These findings were similar to previous studies.

Wu et al reported that endometriosis was found in one-third of SMBT [5]. Endometriosis was twice as frequent in the present study. A previous report showed that T2 shading is a sensitive, but not specific sign for endometriosis [11]. On

the other hand, "T2 dark spots", well-defined hypointense foci due to chronic clot retraction within the ovarian cystic lesion, have low sensitivity but high specificity for endometriosis; these could help differentiate endometriosis from hemorrhagic cysts. Endometriosis is a common disease, defined as the presence of endometrial glands and stroma outside the uterus, and is estimated to affect approximately 10% of women of reproductive age [12,13]. Malignant transformation is rare, and is estimated to occur in 0.6–0.8% of women with ovarian endometriosis [14]. Endometrioid carcinoma and clear cell carcinoma are common histological subtypes associated with endometriosis [14,15]. Seromucinous borderline tumors (SMBTs) are also considered endometriosis-related neoplasms. MR imaging features of these neoplasms are characterized by mural nodules within endometriotic cysts [14,16,17].

Seromucinous borderline tumors have a low pathological stage and long-term disease-free survival, indicating a good prognosis [1,10]. More than 80% of SMBT are diagnosed as stage I. It presents peritoneal dissemination with the frequency of less than 15% [18]. The recurrence rate and mortality are extremely low [19]. In this study, four of the patients had peritoneal involvement in the MRI, however intraoperative consultation/frozen results showed peritoneal washing cytology specimens of these groups were hypocellular and were negative for malignancy.

There are several MRI features with high specificity for the diagnosis of seromucinous borderline tumors: "papillary solid nodule in the endometriotic cyst," "high SI solid portion on T2WI," and "low SI core on T2WI" [7,8]. The present study also showed some of these features. "T2 shading" in the cystic portion, which suggests endometriosis and "high-SI solid portion with low SI core" were seen in all cases. The pathological features, such as gross papillary architecture, edematous stroma, and fibrous core of solid components, correspond to these radiological findings [8].

SMBT most commonly appeared multilocular cystic mass with the solid component. The ratio of solid portion was predominantly within 10-30% in 6 tumors (46.2%), which the is similar to the literature. In relation to MRI findings, ''T2 WI high SI solid portion '' was extremely high, similar in the previous study.

Limitation

This study had several limitations. First, this study was retrospective. Second, because seromucinous borderline tumor is not common, a limited number of cases have been evaluated. Third, contrast-enhanced images were not available for some patients therefore, enhanced sequences were not evaluated. However, this was unavoidable because of the including long-term patients. Finally, patients who underwent MRI were included in the study, which might cause selection bias.

Conclusion

This study demonstrated radiologically useful findings for the recognized SMBTs. In terms of MR imaging findings intracystic fluid, high SI on T1WI and low SI on T2WI were suggestive of SMBT. Seromucinous borderline tumors had specific features such as a high SI solid portion on T2WI with low SI core with high specificity.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

Funding: *None*

Conflict of interest

The authors declare no conflict of interest.

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How to cite this article:
Ebru Hasbay. Seromucinous borderline tumor of the ovary: Correlation of MRI findings with literature. Ann Clin Anal Med 2023;14(11):1015-1019

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